Electronic Version
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Claims

[c1] A microelectromechanical system (MEMS) based sensor, comprising:

a substrate defining a plane;

a first conductive material layer having a first stress, a first portion of the first conductive material layer being connected to the substrate and extending in a substantially parallel direction to the plane defined by the substrate, a second portion of the first conductive material layer being disconnected from the substrate and extending in a substantially non-parallel direction to the plane defined by the substrate; and

a sensor material layer formed over at least the second portion of the first conductive material layer, the sensor material layer having a second stress that is less than the first stress of the first conductive material layer,

wherein the first and second stresses form a stress gradient that bends the second portion of the first conductive material layer and the sensor material layer formed over the second portion of the first conductive material layer away from the substrate.

[c2] The sensor of claim 1, further comprising a second conductive material layer formed over the sensor material layer, the second conductive material layer having a third stress that is less than the second stress of the sensor material layer, the first, second and third stresses forming a stress gradient that bends the second portion of the first conductive material layer, the sensor material layer formed over the second portion of the first conductive material layer and at least a portion of the second conductive material layer away from the substrate.

[c3] The sensor of claim 1, wherein the sensor material layer comprises a silicon material.

[c4] The sensor of claim 3, wherein the silicon material comprises amorphous silicon.

[c5] The sensor of claim 4, wherein the amorphous silicon comprises hydrogenated amorphous silicon.

[c6] The sensor of claim 1, wherein the sensor material layer comprises a Group III-V semiconductor material.

[c7] The sensor of claim 6, wherein the Group III-V semiconductor material comprises gallium-arsenide.

[c8] The sensor of claim 1, wherein the first conductive material layer comprises a titanium-tungsten material.

[c9] The sensor of claim 1, wherein the first and second stresses are compressive stresses.

[c10] The sensor of claim 2, wherein the first and second stresses are compressive stresses and the third stress is a tensile stress.

[c11] The sensor of claim 2, wherein the second conductive material layer comprises molybdenum-chromium.

[c12] The sensor of claim 1, wherein at least a partial sub-layer of the sensor material layer that is remote from the first conductive material layer has a reduced stress that is less than the second stress.

[c13] A method of fabricating a microelectromechanical system (MEMS) based sensor, comprising:

forming a substrate that defines a plane;

forming a first conductive material layer having a first stress, at least a first portion of the first conductive material layer being connected to the substrate and extending in a substantially parallel direction to the plane defined by the substrate; forming a sensor material layer over at least a second portion of the first conductive material layer, the sensor material layer having a second stress that is less than the first stress of the first conductive material layer;

and

disconnecting the second portion of the first conductive material layer from the substrate,

wherein the first and second stresses form a stress gradient that bends the second portion of the first conductive material layer and the sensor material layer formed over the second portion of the first conductive material layer away from the substrate to extend in a substantially non-parallel direction to the plane defined by the substrate.

[c14] The method of claim 13, further comprising forming a second conductive material layer over the sensor material layer, the second conductive material layer having a third stress that is less than the second stress of the sensor material layer, the first, second and third stresses forming a stress gradient that bends the second portion of the first conductive material layer, the sensor material layer formed over the second portion of the first conductive material layer and at least a portion of the second conductive material layer away from the substrate.

[c15] The method of claim 13, wherein forming the sensor material layer comprises forming a silicon material layer.

[c16] The method of claim 15, wherein forming the silicon material layer comprises forming an amorphous silicon

layer.

[c17] The method of claim 16, wherein forming the amorphous silicon layer comprises forming a hydrogenated amorphous silicon layer.

[c18] The method of claim 13, wherein forming the sensor material layer comprises forming a Group III-V semiconductor material layer.

[c19] The method of claim 18, wherein forming the Group III-V semiconductor material layer comprises forming a gallium-arsenide layer.

[c20] The method of claim 13, wherein forming the first conductive material layer comprises forming a titanium-tungsten material layer.

[c21] The method of claim 13, wherein forming the first conductive material layer and forming the sensor material layer comprise forming layers having compressive stresses.

[c22] The method of claim 14, wherein forming the first conductive material layer and forming the sensor material layer comprise forming layers having compressive stresses and forming the second conductive material layer comprises forming a layer having a tensile stress.

[c23] The method of claim 14, wherein forming the second conductive material layer comprises forming a molybdenum-chromium layer.

[c24] The method of claim 13, further comprising forming at least a partial reduced-stress sub-layer of the sensor material layer remote from the first conductive material layer, the at least partial reduced stress sub-layer having a stress that is less than the second stress.

[c25] The method of claim 24, wherein forming the at least partial reduced-stress sub-layer comprises crystallizing part of the sensor material layer.

[c26] The method of claim 25, further comprising subjecting the sensor material layer to a hydrogen plasma treatment after crystallizing part of the sensor material layer.

[c27] The method of claim 25, wherein forming the sensor material layer comprises forming a silicon layer and crystallizing part of the sensor material layer comprises forming at least a partial polysilicon layer.

[c28] The method of claim 24, wherein forming the at least partial reduced-stress sub-layer comprises irradiating part of the sensor material layer with laser light.

[c29] The method of claim 28, further comprising subjecting

the sensor material layer to a hydrogen plasma treatment after irradiating part of the sensor material layer with laser light.

[c30] The method of claim 28, wherein irradiating part of the sensor material layer with laser light comprises irradiating with excimer laser light.

[c31] The method of claim 30, wherein irradiating with excimer laser light comprises pulsing the excimer laser light.

[c32] A chip-to-chip communication system, comprising:

a first semiconductor chip having at least one of an optical scanner and a laser array; and

a second semiconductor chip having an array of microelectromechanical system based sensors of claim 1,

wherein the array of sensors is aligned with the at least one of the optical scanner and the laser array.

[c33] The system of claim 32, further comprising a back plate having a planar surface on which the first and second semiconductor chips are mounted.

[c34] The system of claim 33, wherein the back plate comprises a printed circuit board.

[c35] The system of claim 32, wherein the first semiconductor chip has a laser array and a collimation lens array associated with the laser array.

[c36] The system of claim 32, wherein the first semiconductor chip has a laser array comprising an edge emitting laser array.

[c37] The system of claim 32, wherein the first semiconductor chip has a laser array comprising an VCSEL laser array.

[c38] The system of claim 32, wherein the first semiconductor chip and the second semiconductor chip are part of a flat panel display system.

[c39] A chip-to-chip communication method, comprising:

emitting an optical signal from a first semiconductor chip using at least one of an optical scanner and a laser array; and

receiving the emitted optical signal at a second semiconductor chip using an array of microelectromechanical system based sensors of claim 1 that is aligned with the at least one of the optical scanner and the laser array.

[c40] A method of in-line calibration of an optical link, comprising:

disposing a microelectromechanical system based

sensor of claim 1 in an optical path of an optical signal carrier; and
sensing at least a portion of an optical signal carried by the optical signal carrier.

[c41] A micro-optical bench, comprising:
a bench surface; and
at least one microelectromechanical system based sensor of claim 1 integrated with the bench surface.